This document contains excerpts from the X-34 Independent Assessment Report (title page shown below). Only those sections which relate to the PBMA element **Program Management** are displayed.

The complete report is available through the PBMA web site, Program Profile tab.

X[34]

Safety & Mission Assurance Review

NASA
Office of Safety & Mission Assurance

June 17, 1998

3.0 X-34 Program Safety & Mission Assurance Processes

3.1 Overarching SMA Processes

3.1.1 SMA Process Maps

Figures 3.1-3.3 are process maps depicting the key elements in the overall X-34 Program safety, mission assurance, and risk management process. Figure 3.1 shows the internal OSC processes. Figure 3.2 depicts the task agreement (TA) relationships established by OSC to implement various Flight Assurance (FA)-related operational responsibilities. Figure 3.3 provides insight into the implementation of SMA processes for the FASTRAC engine program and the multiple roles played by the MSFC SMA office.

Salient features of Figure 3.1 include the central role of OSC FA as a participant in the concurrent engineering process and manager for system safety (ground/vehicle and range) planning and implementation. Also of central importance is the role of the Chief Engineer and the Systems Engineering Lead in managing the embedded risk management process through weekly meetings involving, system leads, working level sub-system managers, and top program managers. Figure 3.1 also captures the independent assessment role played by the Flight Assurance Advisory Board and the “hard-lined” reporting role of the Flight Assurance manager, who reports directly to the Vice President for the Advanced Projects Group (APG).

The extensive delegation of SMA functions to support organizations, as shown in Figure 3.2, is part of the overall Better/Faster/Cheaper approach of the X-34 program. Individual Task Agreements (TA) are managed by the corresponding OSC engineering leads who have “dotted line” or indirect reporting relationships to the OSC/FA manager. It is noteworthy that MSFC SMA serves in a sub-contract role to OSC in providing SMA support to the Main Propulsion System (MPS) development.

Figure 3.3 shows how MSFC SMA simultaneously provides support to the MSFC FASTRAC program office while providing overall X-34 SMA support to the MSFC X-34 Program Manager. The three roles:

- MPS SMA support,
- FASTRAC SMA support, and
- overall SMA support to the X-34 Program

represent an inherent conflict of interest when performed by the same individual.

3.1.2 Concurrent Engineering Process

The X-34 Program is an excellent example of the Better/Faster/Cheaper concurrent engineering environment where large formal board meetings (Configuration Control, Engineering Change, etc.) are replaced with more numerous small meetings, formal and informal, where design and manufacturing issues are resolved. The key to making this work is a central configuration management system, shared CAD design tool suite, and a process that everyone seems to understand. The X-34 Program has three regularly scheduled weekly meetings which provide a relatively "short cycle" risk management/program management control process. The OSC FA manager attends all of these meetings.

Monday: Engineering Review: (serves as the Risk Management Forum)

The engineering review is attended by all system Team Leads along with the Chief Engineer, Systems Engineering Lead, and Flight Assurance Manager. If issues fall within budget constraints, the Chief Engineer is the risk decision executive. If issues have budgetary implications, the Orbital X-34 Program Manager is responsible for the resolution. If the issue is out of contract scope, the NASA X-34 Program Manager must resolve the issue.

Tuesday: Sub-System Review: (serves as the Concurrent Engineering Forum)

The sub-system review is the main concurrent engineering forum. Specific sub-system engineering and design issues are addressed and in most cases resolved at this level. This meeting is typically structured as an in-depth technical review of sub-system issues, and interfaces and integration with other sub-systems.

Wednesday: Senior Management Review

Technical and risk management issues are the primary focus of this meeting. Administrative and future business issues are also addressed. The meeting is briefed to the Senior Vice-President of APG and to the Corporate Technical Officer, and is attended by X-34 Program Manager, Deputy Program Manager, the Chief Engineer, the Lead Systems Engineer, and the Flight Assurance Manager.

Monthly: NASA Program Management Review

In addition to the weekly meetings, OSC provides a monthly briefing to NASA X-34 program management. This meeting typically addresses schedule and cost issues and serves to resolve "out of scope" needs identified by OSC. This meeting includes the OSC X-34 Program Manager, Deputy Program Manager, the Chief Engineer, the Lead Systems Engineer, and the Flight Assurance Manager

Abbreviations used in Figures 3.1-3.3

FA: Flight Assurance / CE: Chief Engineer / SE: Systems Engineer
PM: Program Manager / TPS: Thermal Protection System
GN&C: Guidance Navigation & Control
EIS: Environmental Impact Statement / FONSI: Finding of No Significant Impact
LOX: Liquid Oxygen / GSE: Ground Support Equipment / OPS: Operations
GFE: Government Furnished Equipment

Figure 3.1
X-34 Flight Assurance & Risk Management Process Map
(Safety is an integral part of the OSC Flight Assurance model)

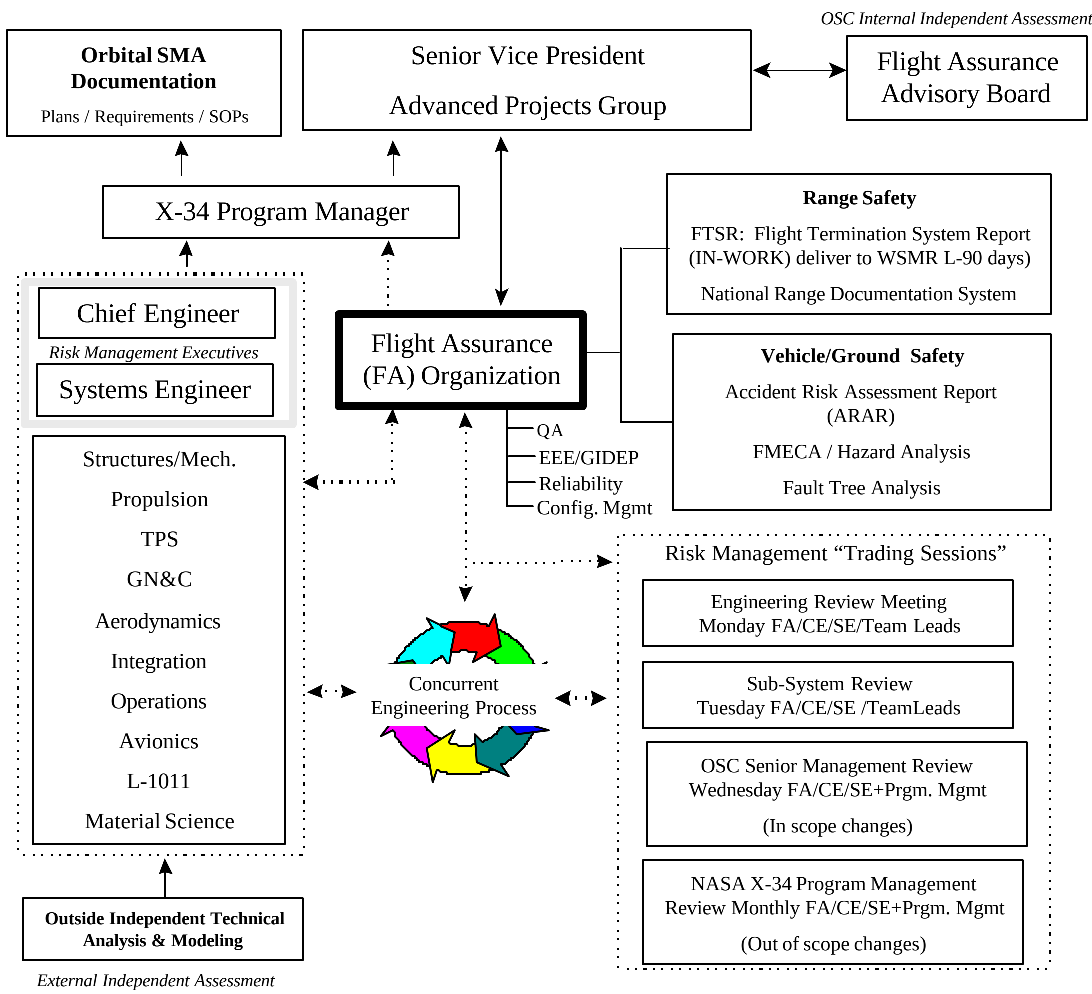


Figure 3.2

X-34 Flight Assurance & Risk Management Process Map
Extension to Supply Chain and Supporting Task Agreements

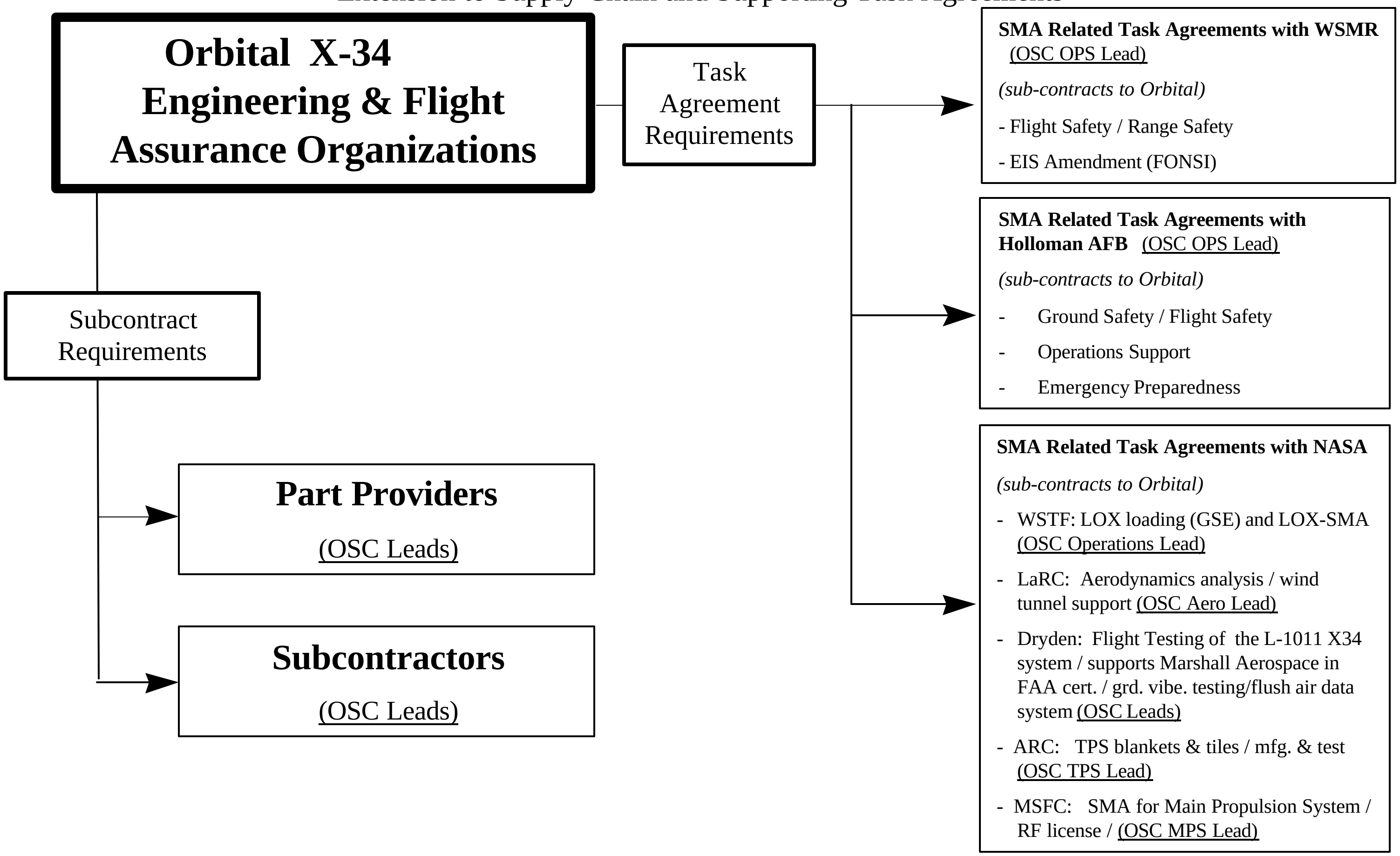
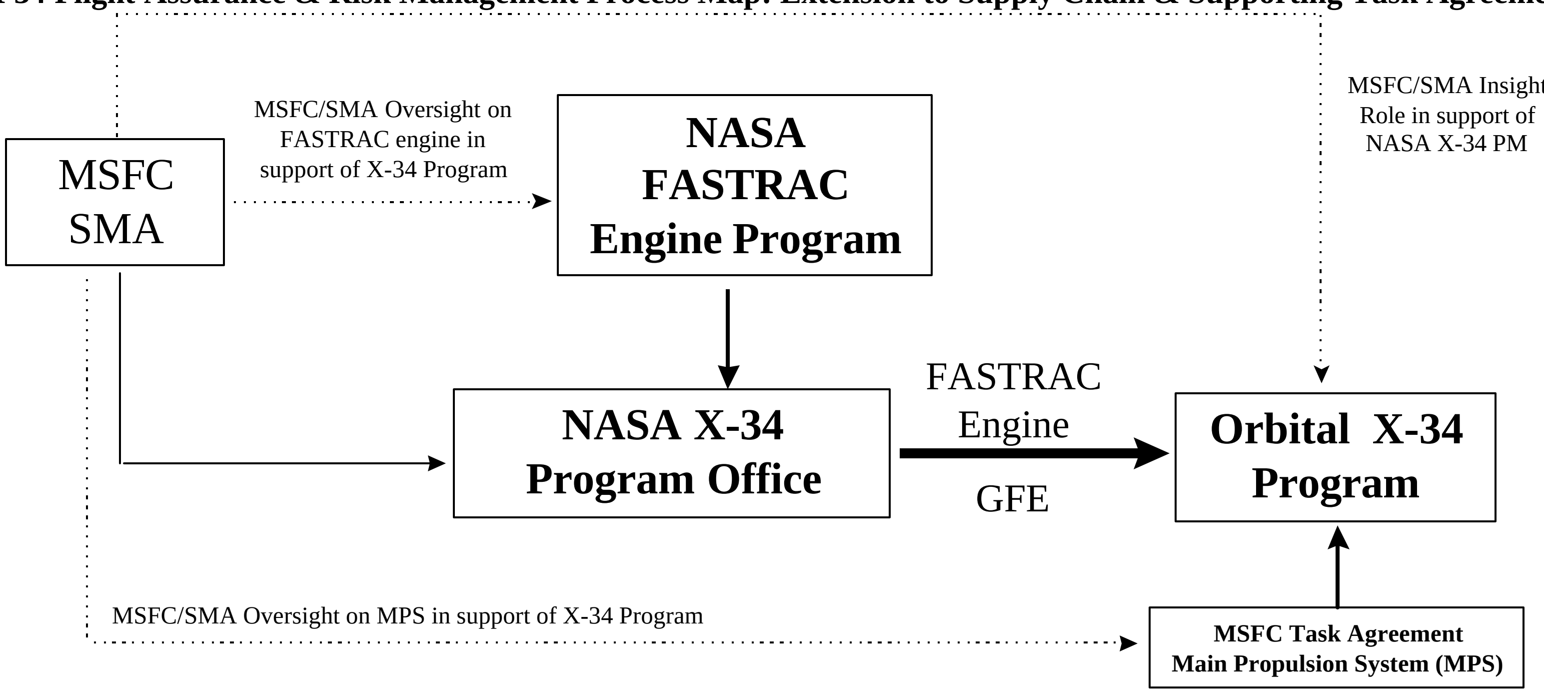


Figure 3.3

X-34 Flight Assurance & Risk Management Process Map: Extension to Supply Chain & Supporting Task Agreements



SMA Insight

Acquiring an *understanding* of safety, mission assurance and risk management processes employed by the performing organization over the life-cycle of a program. Acquiring *visibility* into the implementation of those processes. Developing an understanding of key safety and mission assurance issues associated with the program.

SMA Oversight

Using *customer-imposed* product specifcations and process controls, such as MIL-Specifications, MIL Standards and mandatory inspections, to *direct* the development of the product. Developing an understanding of key safety and mission assurance issues associated with the program.

3.1.3 Risk Management Process

OSC does not have a formal risk management plan for the X-34 program. However, all the steps of an adequate risk management process are in place and functioning; these include risk identification, analysis, planning, tracking, controlling, and documentation and communication. Risk identification includes safety risks from the FMECA, hazard analysis, and fault tree analysis provided by Flight Assurance; contract/schedule/cost risks from Weekly Management Reviews; and current and potential risks from Weekly Engineering Meetings.

Risk analysis includes ranking risks in a Watch List (see example in Figure 3.4). This list identifies each risk area, current rank, prior rank, consequence, current mitigation approach (and additional mitigation actions, if required), mitigation costs, and date of last update. Additional Watch List fields, not shown in the example, were said to include a categorization of the risk: safety, technical, or programmatic. In order to rank them in the Watch List, risks are assessed as to their probability and impact by the Chief Engineer and the Systems Engineer. Note that this assurance process is not formally documented.

Decisions on risk mitigation may also be found in the Issues/Decision Log (Figure 3.5). This log is designed to provide an efficient and effective mechanism for concisely defining and communicating risk issues, identifying affected interfaces; e.g., Flight Assurance, summarizing required updates, and succinctly describing the risk decision status (possibly including mitigation actions). It also identifies programmatic impacts, which include check-blocks for “cost,” “schedule,” “contracts,” and “no impact,” but not for “safety”.

Risk tracking is satisfied through the monitoring of metrics called Technical Performance Measures (TPM) (see Figure 3.6). Risk control appears to be well-integrated into the normal course of project activities; e.g., weekly engineering meetings, weekly program reviews, and monthly project office reviews.

Documentation and communication of risks is accomplished by means of the Issues/Decision Log (with open issues/decisions e-mailed to affected parties weekly), the TPM Tracking File which is updated monthly, the Watch List, Engineering Meeting minutes, and the weekly and monthly briefings at Program Reviews and Project Office Reviews.

Figure 3.4 Risk Management Watch List

Rank (5/1/98)	Prior Rank (3/3/98)	Risk Area	Risk Consequence	Current Risk Mitigation	Additional Risk Mitigation	Cost of Additional Mitigation	Updated
1	1	FASTRAC Engine Availability	Program Delay	X-34 FASTRAC Engine Given 2nd Highest Priority at MSFC. C&V Schedule allows greater margin in Engine delivery date since Engine not required for first flight.	Use of NK-39 Engine to Mitigate Technical Risk		Jan 12 1998
2	2	Engine Operability & Maintainability Requires engine removal, disassembly, assembly & integration.	Increased Turnaround Times		Use of NK-39 Engine to Enhance Operability		Jan 12 1998
3	9	High Speed Corridor Approval / OFTP Commitment	Delay in Off Range flights / EIA is a 2 year process. Need to have OFTP option exercised ASAP to ensure that EIA/EIS is completed in time for the off WSMR flights. Need to ascertain mid range telemetry capability for off WSMR flights.	Low Mach # flights performed within WSMR. High Mach # flights planned at KSC. Mid Range Mach # flights require High Speed Corridor Approval.			May 1 1998
4	11	Lack of Spares for OFTP, EFTP	Delays in Flight Turnaround Operations. Increased Cost of Expedited Components.	None	Procure Spares in Conjunction with Planned Buys of Vehicle 1 and 2 Hardware	TBD	May 1 1998
5	4	Vehicle Mass Growth	Vehicle performance decrease. Inability to eventually attain Mach 8.0.	8.76% Mass Margin (Weight Empty) Remains. Increasing Pressure To Maintain Mass Targets. Assessing Mass Saving Options for A-3 Which Will be Targeted as High Performance Vehicle	Use of NK-39 Engine With Significantly Higher Thrust to Weight Ratio. Mass Optimized 2nd Version of FASTRAC Engine. Purchase a 3rd Wing.		May 1 1998

Figure 3.5 Risk Management Decision Log

Input Form:

Group: Thermal

Entered By: Rahal

Date: 5/19/1998

Title: Metallic TPS Closeouts

Issue: The strake is not conducive to softgoods TPS closeouts due to conflicting requirements - 1) remove blankets without damage, 2) leave no open fastener holes

Interim Decision: ¾” HHB will be affixed to strake up to fastener pattern where FRSI will be applied and punched for access to fastener holes. OSC will provide metallic closeouts over open holes.

Decision Status:
- ☐ Negotiated Decision

Updates Required
- ☐ Drawing
- ☐ Specification
- ☐ ICD
- ☐ Requirements
- ☐ Mass Props
- ☐ No Update

Affected Interfaces
- ☐ Flight Assurance
- ☐ Systems Eng
- ☐ L-1011
- ☐ Ops/Facilities
- ☐ Integration
- ☐ Test
- ☐ Structures
- ☐ Fuselage
- ☐ Control Surfaces
- ☐ Landing Mech.
- ☐ Tanks
- ☐ Wing
- ☐ TPS
- ☐ Propulsion
- ☐ Avionics
- ☐ Hydraulics
- ☐ GN&C
- ☐ Aerodynamics

Programmatic Impacts
- ☐ Cost
- ☐ Schedule
- ☐ Contracts
- ☐ No Impact

Submit Decision

Cancel

Instructions

Log Entry:

Item	Group	Issue Date	Issue Author	Issue Title	Interim Decision/Response	Finalized	Mass	FA	Sys Eng	L-1011	Ops	Integ	Test	Struct Sys	Fuselage	Wing	C Surf	Tanks	L Mechm	Thermal	Prop	Avionics	Hyd	GN&C	Aero
633	Thermal	5/19/98	Rahal	Metallic TPS close outs	¾” HHB will be affixed to strake up to fastener pattern where FRSI will be applied and punched for access to fastener holes. OSC will provide metallic closeouts over open holes.	X	X								X					X					X

Figure 3.6 Technical Performance Measures

			X1	X3	X5	X7	X9	X11	X13	X15	X17	X19	X21
TPM Status	Target	Units	9/2/96	11/21/96	12/3/96	12/12/96	3/3/97	4/29/97	7/1/97	10/2/97	12/19/97	2/27/98	4/24/98
Maximum Mach Number* vs. Mach 8	>8	#	8.40	8.40	7.90	7.60	7.50	7.87	7.40	7.20	6.95	7.06	7.13
Engine Isp	>310	sec	310	310	310	310	310	314	314	314	314	314	314
Engine Thrust	60 -68	Klbf	60.0	60.0	60.0	60.0	60.0	63.9	63.9	63.9	63.9	63.9	63.9
Weight Empty Margin Depletion*	Profile	%	22.35%	21.06%	18.97%	19.15%	17.86%	16.68%	15.53%	13.50%	11.03%	9.82%	8.76%
Weight Empty* vs. Mach 8 Reqt	3000lbs/M	lbs	15132	16113	16017	16475	16210	16478	17293	17815	18058	17903	17747
Weight Empty (NC) vs. Mach 8 Reqt	3000lbs/M	lbs	12368	13309	13463	13827	13753	14125	14969	15696	16263	16302	16317
Total Usable Propellant vs. Mach 8 Reqt	xlbs/M	lbm	29000	29000	27500	27500	27772	27816	27977	27977	27977	27977	27977
Drop Gross Weight*		lbs	44766	45776	44517	45119	45132	45061	46886	47171	47413	47259	47102
Captive Carry Propellant Losses		lbs	1896	1896	1896	1896	1763	1763	1764	1766	1766	1766	1766
Max Gross T/O Weight* vs. L-1011 Capability	52000	lbs	45876	46887	46969	47571	47312	47508	48650	48937	49179	49025	48868
Mass Fraction*		%	0.65	0.63	0.62	0.61	0.62	0.62	0.60	0.59	0.59	0.59	0.59
Max Landing Weight* vs. Gear Capability	22693 (@6 fps)	lbs	16619	17629	17711	18313	18054	18141	19585	20030	20138	19984	19827
Max Landing Speed* vs E/F Tire Limit (w/o drag chute)	<230	Knots	N/A	N/A	203	203	203	203	198	198	198	198	198
Cg (drop) vs. Target Range	396+/-6	inch	400.69	401.10	393.11	396.04	394.80	398.30	399.40	403.50	403.00	402.90	404.20
Cg (landing) vs. Target Range	416+/-6	inch	434.60	437.40	413.37	413.14	410.40	412.00	418.70	426.40	425.00	424.90	424.30

3.1.4 Independent Review Processes

As currently implemented, the X-34 program has both internal and external independent review processes.

External Reviews

At the request of the Associate Administrator for Aeronautics and Space Transportation Technology (Code R), an Independent Technical Assessment Advisory Group was formed at Langley Research Center and chaired by Darrell Branscome. This external independent review team participated in the Outer Mold Line Freeze, December 1996 and the System Design Freeze completed in May 1997. While these two reviews focused on key programmatic and technical design and development areas, the team highlighted several safety and mission assurance issues. All issues were captured through the formal Review Action Recommendations (RAR) process that is described in detail in a subsequent section of this report. In addition, the review team has provided a separate write-up for each review.

Code R also chartered an independent review team to evaluate risk reduction approaches and assess the merit of conducting the optional flight test program. Chaired by Mr. Robert Meyer (Dryden Flight Research Center), the team included members from ARC, DFRC, KSC, JSC, LaRC, LeRC, and MSFC. This review was completed in March 1997. The team was reconvened to assess various X-34 aero-science experiments and operations technologies opportunities. This review was completed in April 1998.

OSC undertook a separate independent review of the X-34 wing design. The wing design is unique because of the requirement to accommodate the trade between the LOX tank diameter and available ground clearance limits for the vehicle when mounted under the L-1011 carrier aircraft. Quartas Engineering conducted this review from December 1997 through May 1998. Quartas Engineering analyzed the wing carry-through spar and the wing/fuselage interface and considered material and design load allowables, factors of safety, finite element model (FEM) approaches and overall design philosophy. The review team determined that each of these areas has been satisfactorily addressed and considers the overall wing design to be sound.

The MSFC Payload Assurance Office conducted a quality assurance audit in November 1997. This review focused on the quality system being implemented for the X-34 program at the OSC facility in Dulles, Virginia. While the findings from this audit were largely positive, several areas were identified as needing attention. The MSFC X-34 Program Office and OSC have addressed and appropriately dispositioned each of the findings and observations.

Internal Reviews

OSC has a formally established Flight Assurance Advisory Board. This Board reports to Dr. Antonio Elias, Senior Vice President of APG and is comprised of the Flight

Assurance Directors from the Launch Systems Group and the Space Systems Group, Mr. David Low and Mr.Tom Manson, respectively. Two other senior-level individuals, Mr. Alton Jones and Mr. John Boechel, complete the membership of the Board. The purpose of the Board is to advise the Senior Vice President of APG on issues of safety and mission assurance relative to the various flight projects under his perview.

OSC has formed an internal assessment team, known as the "Blue Team" to participate in various major program reviews. The Blue Team parallels the Independent Technical Assessment Advisory Group, chaired by Darrell Branscome. The team is made up of members from OSC and MSFC who are not directly involved in the X-34 program. To date this review team has participated in each of the major program reviews, (i.e. System Requirements Review, Outer Mold Line Freeze, and System Design Freeze) and will participate in the System Verification Review when scheduled. This team provides its inputs/comments/concerns through the formal RAR process.

3.1.5 Configuration and Data Management

Configuration and data management (CM/DM) for the X-34 Project is accomplished in accordance with OSC Advanced Projects Group (APG) Configuration and Data Management Standard Operating Procedures (TD-9007 Rev A). Unique X-34 Program CM/DM requirements and procedures are identified in the X-34 Program Configuration and Data Management Plan (TD-9102 Rev A). This plan, prepared in conformance with MIL-STD 973, describes the X-34 CM organizational structure, program unique configuration identification, control, status accounting procedures, and configuration audits for technical description data.

<u>Configuration Baselines</u>

As defined and implemented by OSC on the X-34 Program, a configuration baseline represents a configuration identification document or a set of technical documents formally designated and fixed at a specific time during a Configuration Item's (CI) life cycle. Baselines establish a point of departure for the control of subsequent changes and facilitate accounting for the incorporation of approved changes. Thus, the initial baselines, plus approved changes to those baselines, constitute the current configuration identification.

<u>Functional and Allocated Baselines</u>

The performance, design, development, and test requirements for the X-34 System are defined in the X-34 System Specification (X60005). The configuration thus defined constitutes the Functional Baseline - or the initial Functional Configuration Identification FCI). At any point in the X-34 system life cycle the current FCI can be defined as the initial Functional Baseline plus all approved changes to that baseline.

These same requirements are then allocated to the main functional segments or configuration items (CI) which consist of the 1) X-34 Vehicle, 2) X-34 Carrier Aircraft

(L-1011), and 3) X-34 Operations and Facilities. The performance, design, development, and test requirements of these configuration items are documented in the segment specifications X60006, X60007, and X60008 respectively. These specifications constitute the CI's Allocated Baseline, also known as the initial Allocated Configuration Identification (ACI). As described above, at any point in the CI"s life cycle, the current ACI is defined by the Allocated Baseline plus all approved changes to that baseline.

Product Baseline

The Product Baseline or initial Product Configuration Identification (PCI) for the X-34 system is defined as the "as-built" configuration of each segment or CI for the first powered flight mission (vehicle A2), i.e. as-built for the powered flight vehicle, as-modified for the carrier aircraft, and as-built ground support equipment. The as-built configuration is documented at the integration facility by the vehicle log which includes the quality records of all items delivered to the facility, the integration procedures use to build that CI, the complete work orders where applicable, Non-Conformance Reports (NCR), Field Discrepancy Reports (FDR), and the vehicle weight logs.

Subcontractor Design Baseline

OSC requires a design baseline for those subcontractors responsible for both design and manufacturing of a CI. This enables OSC to be involved with change control prior to the formal establishment of the product baseline for the configuration item of interest. This design baseline is established upon OSC receipt and approval of the subcontractor's design data package.

Configuration Control Classifications

Change control is implemented on all segment and lower-level configuration items. The classification of X-34 internal engineering changes generally follows the guidelines of MIL-STD 973 with minor modifications as defined below:

> Class I - Any technical change to the Functional or Allocated Baseline outside of specified limits or tolerances is considered a Class I change. After establishment of a subcontractor design baseline or product baseline a change to any document or piece of software is defined as Class I if it affects the CI's interchangeability, performance, reliability, safety, mass properties (significantly), electrical or mechanical interfaces, electromagnetic characteristics or qualification status.
>
> Class II - Those changes which do not fit into the Class I category

Class I changes require Orbital approval and Class II changes require Orbital classification concurrence.

Engineering Change Notice

Class I engineering changes must be approved by the program manager or his designee prior to incorporation into the released documentation. This approval is obtained by submitting an Engineering Change Notice (ECN). The ECN is the principle configuration management tool for recording, approving and releasing changes to formally released drawings and engineering documentation. The program Configuration Administrator maintains a database of all ECNs. The ECN is logged into the database and a copy of the ECN is filed. Action items associated with any deferred ECN are contained in the Configuration Control Board meeting minutes. The actionee is responsible for providing the information or documentation necessary to resolve the action to the Configuration Administrator so the deferred ECN can be resolved at the next Configuration Control Board meeting. The status of the ECN is updated in the database until all impacted drawings identified in the ECN have been changed.

Configuration Control Board

The Configuration Control Board (CCB) reviews all proposed Class I engineering changes to the established engineering baseline. The CCB is the forum for all program technical areas to evaluate proposed changes and discuss the overall system-level impact of the proposed change and either approve or disapprove the change.

The X-34 program Configuration Control Board is comprised of the following members: Chief Engineer, Flight Assurance Manager, Configuration Administrator, Lead System Engineers, and Segment Level Lead(s) (Vehicle, Operations, L-1011) as required.

The X-34 Program Manager has delegated his responsibility as the CCB chairman to the X-34 Chief Engineer. As such, the Chief Engineer's signature is required to approve any proposed Class I change to baselined engineering. It is the chairman's responsibility to convene the appropriate members of the CCB at the appropriate frequency to provide him with sufficient council to determine the disposition of proposed changes. The participation of the engineering staff will be determined by the scope of the change. It is the chairman's prerogative to approve/disapprove an ECN without formally convening the Board. The CCB/ECN process is described in Figures 3.7 and 3.8.

Figure 3.7 Configuration Control Process

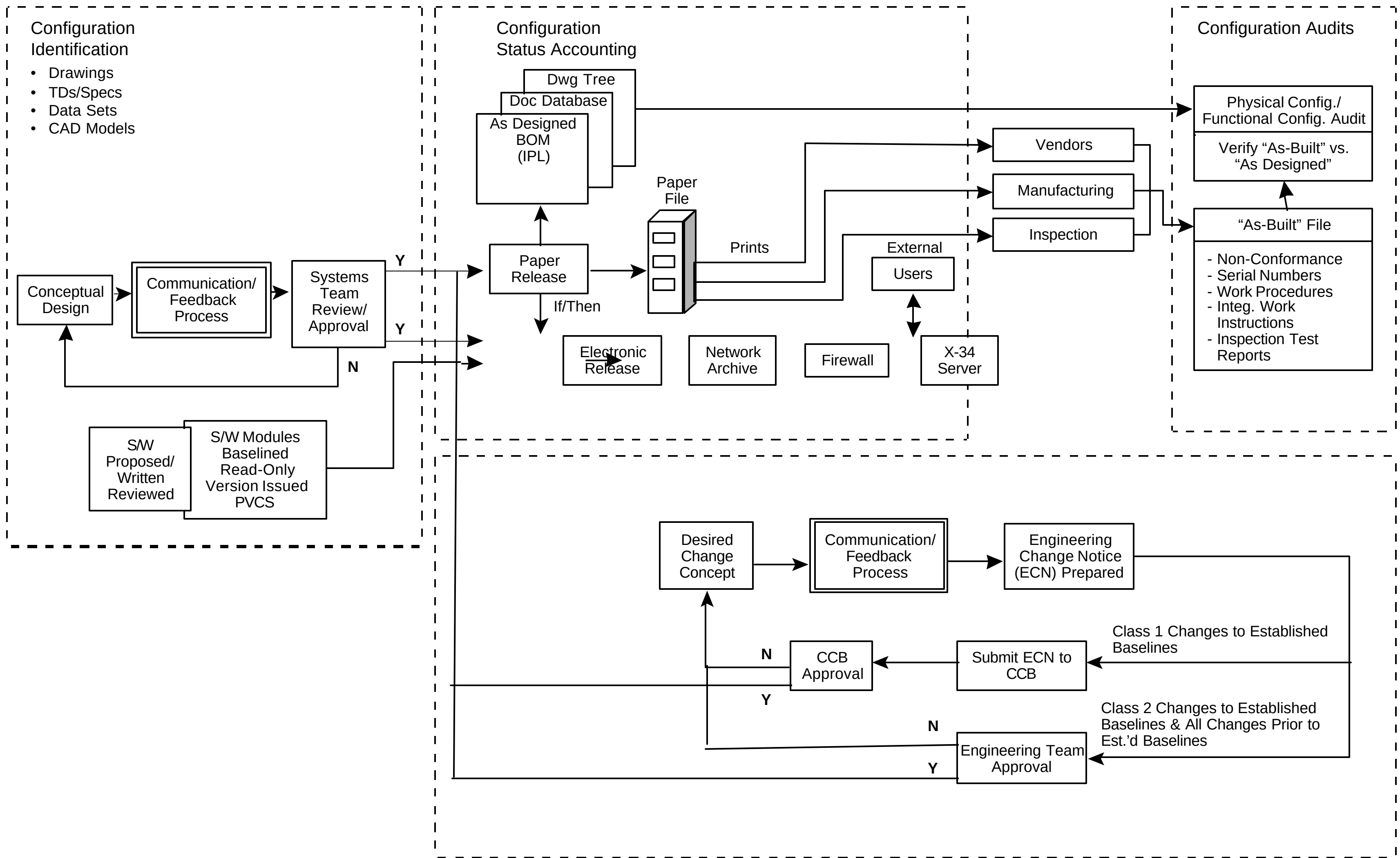
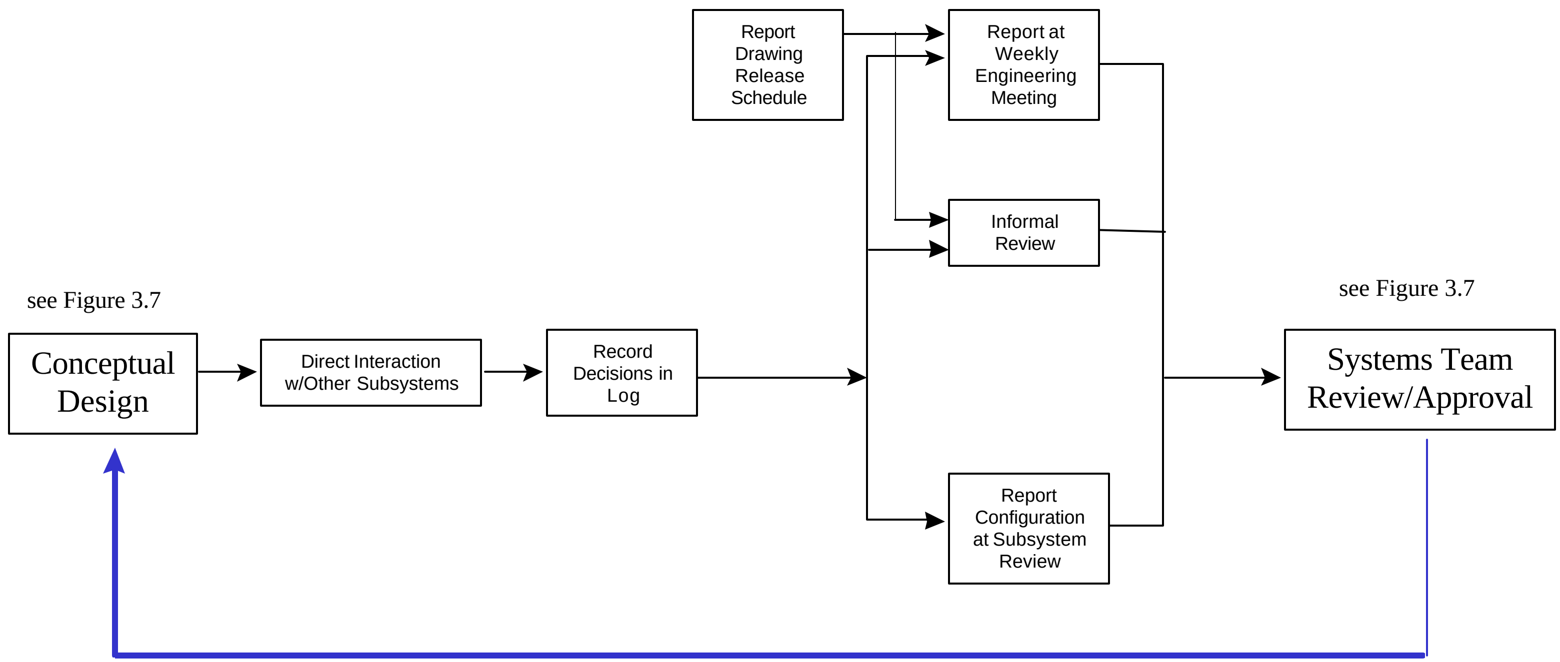


Figure 3.8 Communication/Feedback Process



Electronic File Control

All personnel have accounts on the NOVELL server/network that permits access to subdirectories which are established to assist in electronic configuration control. In addition, an NT server/network exists which links all computer-aided design (CAD) stations utilizing the IDEAS CAD software tool to facilitate CAD mechanical drawing storage, control, and access. Specific network directories exist for CM released electronic files. In order to maintain data integrity, users have restricted read and write privileges in various subdirectories. The ORCAD system is used for the design and control of electrical parts, electrical subassemblies, and schematics.

Non-Conformance Report (NCR) and Field Discrepancy Report (FDR)

NCRs and FDRs are used for identifying discrepancies between as-designed and as-built configurations. NCRs are used to identify discrepancies with items that are received or processed at OSC's Dulles facilities. FDRs are used to identify discrepancies with items that are received or processed at field site facilities. An NCR or FDR written against an error on a drawing can not be formally closed until the documents identified on the NCR or FDR has been changed via the CCB/ECN process.

The X-34 NCR format is the same as that used by all programs in the Space Systems Group at Orbital and consists of the following elements:

- Section 1 - Detailed Description of Discrepancy
- Section 2 - Disposition of Discrepancy
    - MRB (Use-as-is or Repair) - Requires concurrence of Subsystem Lead Engineer and Flight Assurance Manager
    - Non-MRB (scrap, return to vendor, rework) - Requires concurrence of Cognizant Engineer and Quality Assurance
- Section 3 - Cause and Corrective Action
    - Identification of the root cause of the discrepancy
    - Corrective action to be taken to prevent recurrence
- Section 4 - Close Out
    - Final acceptance of implemented corrective actions

The NCR and FDR database will be maintained at the Dulles facility using the Orbital Technical Information System (OTIS).

L-1011 Aircraft Configuration Control

An X-34 Vehicle/L-1011Aircraft Interface Control Document (ICD) is prepared and controlled in accordance with the configuration control processes described herein. Prior to first time release and release of changes, the ICD required approval signatures from both sides of the vehicle/aircraft interface. Engineering documentation and software associated with any X-34 related modifications to the L-1011 will be generated and controlled per the L-1011 Aircraft Configuration Management Plan (TD-0221).

Configuration Audits

There are two basic types of configuration audits performed internally by OSC for the X-34 program.

The Physical Configuration Audit (PCA) is the comparison of actual hardware to the released engineering drawings that define the desired configuration:

- The Quality Assurance (QA) engineer performs incremental PCAs of parts as they are processes via incoming QA inspection procedures.
- Parts are checked against the Indentured Parts List (IPL) prior to integration into their next higher assembly.
- A program management level review of the configuration history of all major components is held prior to shipment of the vehicle to the field site.

The Configuration Administrator provides assistance and information to the QA engineer and the program office during these incremental PCAs.

The Functional Configuration Audit (FCA) is the comparison of actual performance test results to the specification requirements. The as-designed component configuration is reviewed against the specification or requirement documentation by the principal systems engineer during the design phase. The QA engineer reviews test results and documentation and insures the results meet specification requirements. The Configuration Administrator provides assistance and information to the appropriate systems engineer during these incremental FCAs. Any discrepancy identified during these audits is documented on an NCR.

QA inspects all flight hardware. Only the non-flight items that are required for system testing are inspected and verified by QA, i.e., mass simulators used on the Captive Carry Vehicle. QA inspection for tooling used for fabrication is at the discretion of the cognizant engineer.

4.2 Staffing Levels for SMA

The X-34 program Flight Assurance organization is operating at a minimum staffing level, comprised of three full-time professionals. This lean approach renders the program potentially vulnerable to unexpected events. While viewed as a percentage of the overall X-34 program staff (5%), the SMA staffing is comparable with larger programs. This may be a misleading perspective however as implementation of the required SMA task-set requires a finite or minimum number of professional staff. Therefore, embedded risk exists in the potential for compromising SMA process implementation by over-burdening SMA staff. Corporate OSC resources should be available to bolster, as necessary the SMA (Flight Assurance) functions in the X-34 program. NASA MSFC X-34 program management and SMA management should be vigilant in assuring the effectiveness of

SMA process implementation. The OSC Flight Assurance full-time staffing should be expected to increase if the program implements the optional flight test program.

4.6 Design, Engineering and Management System Security

The X-34 program employs a design and engineering data base which is available to industry and government partners by way of a password protected FTP-internet site. The information contained in this data base is read-only. It is also important to note that the internet accessible CAD (computer aided design) environment is in a support role to a more traditional printed drawing system which is maintained under internal OSC configuration control.

Information security is an element in the overall mission success equation. While the X-34 program does not have a formal information security plan in-place, it does employ, basic computer management system security practices. It is acknowledged that an intensive technical review of information security measures, while beyond the scope of this review and report, may provide opportunities for enhancement. The X-34 program management team is encouraged to consult further with the NASA Inspector General and Office of Security on this matter.